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# PATENT SPECIFICATION

DRAWINGS ATTACHED

1.169.059



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## COMPLETE SPECIFICATION

### An Arrangement of Pole-Changing Motors in Washing Machines

We, HOLZER-PATENT A.G., a body corporate organised under the laws of Switzerland, of 5 Bahnhofstrasse, Zug, Switzerland, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

The purpose of washing machines, for laundry washing and spinning, is first to carry out a washing action at a low speed and then to spin the wash at a high speed. For this purpose, use is often made of pole-changing motors, which impart motion to the drum through a drive.

The speeds aimed at for washing are in the vicinity of 50 revolutions of the drum per minute. For spinning, the highest possible speeds are desired—about 800—1,000 revolutions per minute. Pole-changing motors can be produced economically only for a speed ratio of between 2:12 and 2:18, equivalent to a direct speed ratio of between 1:6 and 1:9. A speed ratio of 1:16 to 1:20 cannot be realised with pole-changing motors. Additional intermediate gears are needed to attain such speed ratios.

The purpose of the invention is to save additional gearing and find a direct arrangement whereby an increase in the ratio between the washing and spinning speeds can be achieved economically and reliably, without mechanical difficulties.

According to the present invention there is provided an arrangement for increasing the speed ratio of the spinning and washing speeds of washing machines including a pole-changing motor having windings for providing the washing and spinning speeds as desired, the speed corresponding to the wash winding of the motor being arranged to be considerably higher than the washing speed, and a speed regulator is provided to reduce this speed to the required washing speed.

[Price 4s. 6d.]

Preferably, said speed regulator is an electronic speed regulator. This method represents a completely new approach to the problem. One can now use pole-changing motors having a speed ratio of, for example, 1:6. These motors are cheap to make, they are lightweight and small and the gearing that would normally be indispensable for such motors is replaced by electronic speed regulation. This regulation is itself so designed that it operates only over quite a small range, its particular purpose being to reduce the speed that is too high for washing. Instead of this electronic speed regulator, of course, other conventional means are equally possible, so long as they enable the drive power of the washing machine motor to be reduced so as to cut down its speed. The pole-changing motor, the speed ratio of which is changed by the purely mechanical arrangement of the poles, is supplemented by an electronic speed regulator. To some extent, the pole changing represents the course speed regulation, while the electronic speed regulator represents the fine regulation. The fine regulation is thus effective only within the narrower range—for instance, in the case of a motor having one speed of 600 r.p.m. and the other of 100 r.p.m., within the range from 100 to 50 r.p.m. or, according to circumstances, to 30 r.p.m. The advantage of this additional electronic speed control, which occupies but little space, operates almost contact-free through the employment of transistors, is easy and cheap to manufacture and can be switched by the programme contacts, is that the speed ratio of 1:6, which is that of this motor, can be increased to 1:12 by reduction from the spinning speed of 600 r.p.m. to the washing speed of 50 r.p.m. Should one wish to reduce still further with the aid of the electronic speed regulator—to 30 r.p.m., for example, when it is desired to use a gentle speed for wash-

ing— this speed ratio would be widened to 1:20. The means used for this are particularly suitable for running washing machines, since they operate contact-free, are robust and shock-proof and will still work perfectly despite possible fluctuations in frequency and working voltage.

Of the many possible electrical control circuits, one that offers special advantages employs impulse-controlled intermittent regulation as the electronic speed regulator. This impulse-controlled intermittent regulation reduces the drive power. The motor, which may have its speed reduced by pole changing to 100 r.p.m., for example, now receives its driving power only in impulses. These impulses may be of equal duration, i.e. the intervals between individual pulses are equal, or these intervals and/or the impulses may differ in length.

For the speed regulation, it is also important for the impulses to be controlled by a tachometer on the motor shaft.

If one wishes to adapt the speed regulation precisely to requirements, the actual speed must be measured, which can be done by converting the motor speed into an electrical magnitude, in addition to which one requires a reference voltage corresponding to the desired speed.

For a circuit arrangement of this kind, it has been found advantageous for the speed to be regulated by a differential amplifier, which acts as a threshold-value switch and feeds the output signal to a switching amplifier.

A differential amplifier that can be operated with transistors may be termed a current gate, which opens or closes according to the result of comparing the desired and actual speeds or the electrical magnitudes equivalent to them. The switching amplifier, which is likewise designed to operate on the semiconductor principle, is also contact-free, so that the reliable operation of such an arrangement is fully maintained.

A further point of material interest is that the reference voltage equivalent to the desired speed is received by the differential amplifier via programme contacts, while the voltage equivalent to the actual speed is supplied to the differential amplifier by the tachometer.

By the use of the differential amplifier and connection through programme additional contacts controlled by a programme switching unit, it is possible for this differential amplifier, during spinning, for instance, to be employed to control other switching processes. It would be equally possible, of course, to design the electronic speed regulator in such a way as to operate both in the spinning speed range and in the washing speed range.

If such programme contacts are to be used

for connection, it is important that the reference voltage be tapped from a voltage divider.

The programme contacts, which are provided in any case on any fully automatic washing machine and are also used even with semi-automatic washing machines, have only very low currents to transmit, which are fed as input voltages to the differential amplifier. Printed circuits can therefore be used, since slight contact burning is only to be expected. This further cheapens the arrangement as a whole.

One preferred example embodying the arrangement for increasing the speed ratio of washing and spinning speeds for washing machines according to the present invention is shown in the accompanying drawings, in which:—

Fig. 1 is a circuit diagram illustrating the principle of using motor pole changing in conjunction with electronic speed regulation;

Fig. 2 shows diagrammatically how it is possible to extend the range of regulation of the motor of Fig. 1; and

Fig. 3 shows the circuit of the differential amplifier.

Referring to the drawings, Figure 1 shows by way of example one possible circuit for a motor 1 with its two windings 2 and 3 corresponding to the various pairs of poles. By way of the programme switching contacts 4 and 5, the electronic speed regulator 6 can be placed in circuit, as desired, with these windings 2 or 3. A tachometer generator 7 which has the same speed as the motor shaft 8 by virtue of the provision of a direct drive, supplies to the electronic speed regulator 6, the "actual" voltage, equivalent to the actual speed of the motor 1. The resistors 9, 10 and 11, form a voltage divider between the lines 20 and 21, and supply the "desired" voltage, equivalent to the desired speed, to the electronic speed regulator 6, according to which of the programme contacts 12 and 13 is operated. It may be that, as shown in Figure 2, the closing of the programme contacts 12/4 corresponds to the spinning speed  $n_2=600$  r.p.m. This spinning speed will be reduced to a speed of  $n_{12}=100$  r.p.m. when the programme contacts 5/13 close. The motor here has a ratio of 1:6 or 2:12 between the pole pairs. The electronic speed regulator is intended to operate from this speed  $n_{12}=100$  r.p.m. It is also possible that, according to which of the programme contacts 12 or 13 is closed, the speed attained will be either  $n_w=50$  r.p.m., i.e. the washing speed proper, or, if the other contact be closed, the speed  $n_{30}$ , which is the gentle washing speed of 30 r.p.m. According to the voltages tapped off the voltage divider 9, 10 and 11, the electronic speed regulator will then operate within regulating range 22. The operation of the

differential amplifier can be seen from Figure  
 3. The electronic circuit consists of a differen-  
 tial amplifier with transistors T2 and T3  
 and collector resistors R5 and R6, along with  
 5 a common emitter resistor R4. This differen-  
 tial amplifier acts as a threshold-value switch.  
 The output signal of the differential ampli-  
 fier is picked up at the collector of the tran-  
 sistor T2 and taken to a switching amplifier  
 10 T1, the operating voltage of which is derived  
 from a voltage divider R1/R2. As soon as  
 the voltage of the tachometer generator 7,  
 which is rectified by a diode D1, smoothed  
 with the aid of a capacitor C1 and applied  
 15 to the base of the transistor T2, becomes  
 greater than the reference voltage on the  
 base of the transistor T3, tapped off the  
 voltage divider 9, 10 and 11 through the  
 programme contact 12 or 13, the transistor  
 20 T3 is cut off and the transistor T2 becomes  
 conductive. The transistor T1 thus acquires  
 a negative potential on its base, which cuts  
 it off so that the control signal for power  
 semi-conductor 14 which may be a triac  
 25 device, is interrupted. In this way, the cur-  
 rent feed to the motor 1 is cut off.

When the tachometer voltage on the base  
 of the transistor T2 has dropped once more  
 below the value of the reference voltage on  
 30 the base of the transistor T3, the transistor  
 T2 is cut off and the transistor T3 becomes  
 conductive. The transistor T1 thus operates  
 the power semi-conductor 14 again.

A capacitor C3 and a resistor R7, which  
 35 lie in circuit with the motor windings 2 and  
 3, serve to operate the motor in the con-  
 ventional way and to protect the triac de-  
 vice 14 by short-circuiting any harmful vol-  
 tage peak pulses that may occur, whereby the  
 40 triac device will suffer no damage when it is  
 cut out. The mains side, which feeds the  
 differential amplifier with the switching am-  
 plifier, consists of a transformer Tr, a diode  
 D2 and a capacitor C2.

#### 45. WHAT WE CLAIM IS:—

1. An arrangement for increasing the speed  
ratio of the spinning and washing speeds of

washing machines, including a pole-changing  
 motor having windings for providing the  
 washing and spinning speeds as desired, the  
 speed corresponding to the wash winding of  
 50 the motor being arranged to be considerably  
 higher than the washing speed, and a speed  
 regulator is provided to reduce this speed to  
 the required washing speed. 55

2. An arrangement as claimed in claim 1  
 wherein said speed regulator is an electronic  
 speed regulator.

3. An arrangement as claimed in claim 1  
 in which the electronic speed regulator is an  
 impulse-controlled intermittent regulator. 60

4. An arrangement as claimed in claim 3  
 in which the impulses are controlled by a  
 tachometer mounted on the motor shaft.

5. An arrangement as claimed in any of  
 claims 1 to 3, in which the electronic speed  
 regulation is brought about by a differential  
 amplifier, which acts as a threshold-value  
 switch and feeds the output signal to a switch-  
 ing amplifier. 70

6. An arrangement as claimed in claim 5  
 in which a reference voltage equivalent to  
 the desired speed is received by the differen-  
 tial amplifier through programme contacts,  
 while a voltage equivalent to the actual speed  
 75 is supplied to the differential amplifier by  
 the tachometer.

7. An arrangement as claimed in claim 6  
 in which the reference voltage is tapped off  
 a voltage divider 80

8. An arrangement for increasing the speed  
 ratio of washing machines, substantially as  
 herein described, with reference to and as  
 shown in the accompanying drawings.

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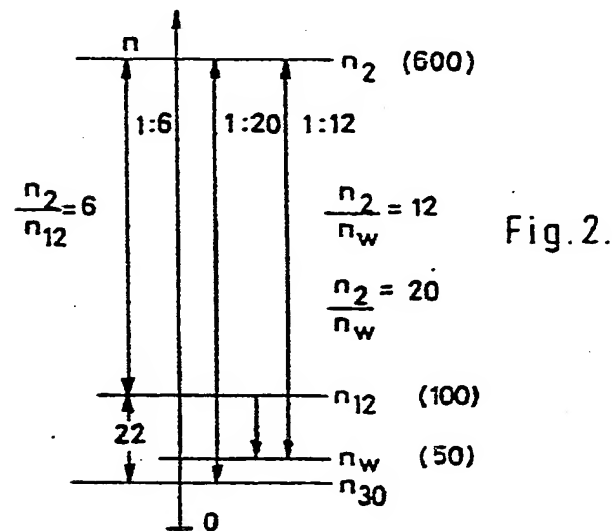
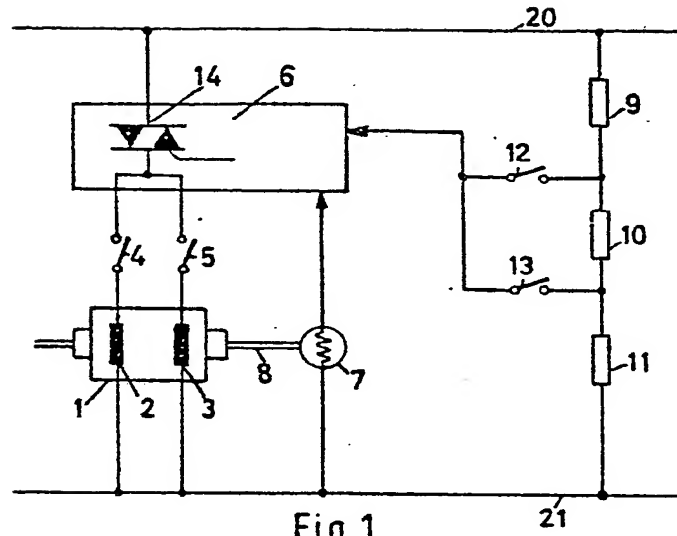
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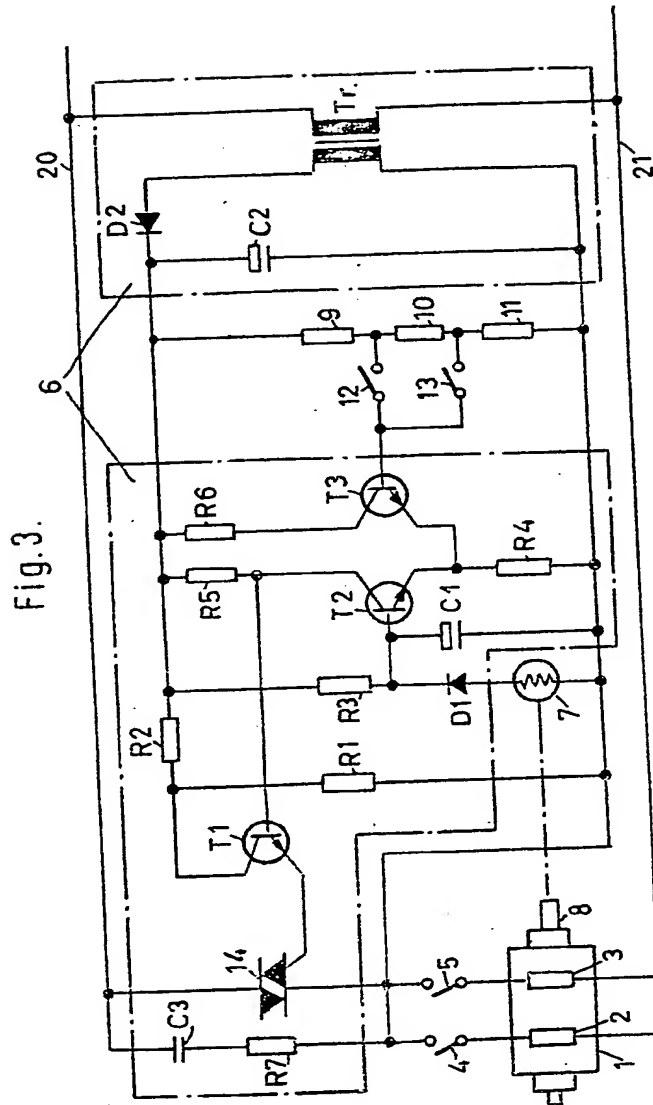
## COMPLETE SPECIFICATION

2 SHEETS

This drawing is a reproduction of  
the Original on a reduced scale

Sheet 1





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